SPECIFICATION

ATTORNEY DOCKET NO. 0317MH-34834CIP

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, **DANIEL A. HENDERSON**, a citizen of the United States of America, residing in **Hudson Oaks, Texas**, and has invented new and useful improvements in an

ENHANCED CALL-WAITING WITH CALLER IDENTIFICATION
METHOD AND APPARATUS USING NOTCH FILTERS

of which the following is a specification:

1   **CROSS REFERENCE TO RELATED APPLICATION**

2   This application is a continuation-in-part of U.S. Patent application,

3   Serial No. **08/963,689**, filed **4 November 1997**, entitled *"ENHANCED*

4   *CALL-WAITING WITH CALLER IDENTIFICATION METHOD AND*

5   *APPARATUS"*, now issued United States Patent No. **6,339,639**, issued

6   **15 January 2002**, which is a continuation of U.S. Patent Application

7   Serial No. **08/832,945**, filed **4 April 1997**, entitled *"ENHANCED CALL-*

8   *WAITING WITH CALLER IDENTIFICATION METHOD AND APPARATUS"*

9   which is incorporated herein by reference as if fully set forth herein.

10

11   **BACKGROUND OF THE INVENTION**

12

13   The invention relates generally to telephone subscriber services and

14   more particularly to improved call-waiting with caller identification services

15   and apparatus.

16

17   **DESCRIPTION OF THE PRIOR ART**

18

19   The call-waiting with caller identification telephony feature is

20   becoming more popular as a service offered by many telephone operating

21   companies.

22   Several early versions of call waiting services are discussed in U.S.

23   Patent 3,133,995 issued to Zarouni, U.S. Patent 3,963,874 issued to

24   Pommerening et al., U.S. Patent 3,997,731 issued to George et al., U.S.

25   Patent 3,584,156 issued to Beth, and U. S. Patent 4,661,975 issued to

26   Brecher. Other systems are described in U.S. Patent 4,873,719 issued

27   to Reese and U.S. Patent 5,583,924 issued to Lewis.

1   In US Patent 5,263,084 issued to Chaput et al. is shown an
2   improved system and apparatus that mutes the handset in response to
3   receipt of a call-waiting signal to allow receipt of a coded FSK signal that
4   represents the identity of a third communicant while a conversation is
5   taking place between a first and a second communicant. This is a great
6   advantage in that noise signals created by the FSK data transmission will
7   not be heard by the first and second communicants during data
8   transmission but the first communicant can still know the identity of the
9   third communicant by viewing a display.
10

11   The disadvantage of the Chaput approach is that the mute
12   condition must occur upon receipt of a call-waiting signal at the CPE,
13   even when no data is yet being transmitted from the local switching
14   office. This is inconvenient and inefficient because the system is muted
15   for an unnecessary interval of time during which communication could
16   occur between the first and second parties.

17   The present call waiting with caller id systems provide that the
18   second party is placed in a mute condition for a predetermined period of
19   time by the local switching office at the time the call waiting signal is
20   sent to the first party. This occurs so that the second party will not
21   have to listen to the modem transmission of FSK data (that represents
22   the identity of the third party) that is transmitted to the first party
23   apparatus for display. However, this implementation is inconvenient for
24   the second party in that it requires a muted condition not only during the
25   data transmission, but for some predetermined time before and after the
26   data transmission occurs which could be otherwise utilized for
27   conversation between the first and second party.

1   Even momentary interruptions in a voice conversation have been

2 known to cause miscommunication between communicants, as in the

3 case where telephone number or credit card number data is being

4 exchanged between the first and second communicant. In the case of

5 long distance communication between the first and second party,

6 unnecessary charges are incurred for a telephone call so long as the

7 parties are connected, even if they are not able to speak to each other.

8 Therefore, it is desirable to minimize the amount of time that

9 communication is interrupted by unnecessary muting of the handset.

10   Although muting can have benefits in preventing communicants

11 from hearing the noise associated with FSK data communication, it may

12 result in wasted time and expense for communicants already engaged in

13 a conversation who are unable to efficiently communicate during the

14 muted period.

15   What is needed is an improved method and apparatus that

16 minimizes the amount of time that the handset is muted for a first

17 communicant, while allowing data transmission to occur that identifies a

18 third party. Conventional call waiting systems initiate a second party

19 mute condition at the time a call waiting signal is sent. However,

20 dependent upon changes that could easily be implemented at the local

21 switching office affecting the timing of the second party mute condition

22 created by the local switching office, a second party mute condition

23 could also be modified to take advantage of the invention herein so that

24 a first and second communicant would have more time available to

25 continue their conversation and exchange information. Even in the case

26 where no changes were made at the local switching office to reduce the

27 mute period for the second party, the invention described hereinafter is

1 compatible in conventional call waiting systems but could be used in

2 future call waiting systems to minimize the mute condition of the second

3 party as well.

4

1 # SUMMARY OF THE INVENTION

2   It is one object of the invention to allow for an improved caller

3 identification with call waiting system and apparatus that is compatible

4 with current caller identification services while providing for future

5 services that could be implemented.

6   It is another object of this invention to provide an improved

7 method and apparatus of providing identification information related to a

8 calling third party to a first party already engaged in conversation with a

9 second party.

10   It is another object of this invention to provide to a first party

11 already engaged in a telephone conversation with a second party an

12 improved apparatus which minimizes the amount of time its' associated

13 handset is muted to allow for transmission and receipt of identification

14 information related to a calling third party.

15   It is another object of the invention to provide to a first party

16 already engaged in a telephone conversation with a second party an

17 improved apparatus which mutes its' associated handset in response to

18 receiving a predetermined time period of mark information in an FSK

19 multiple data message representative of identification information related

20 to a calling third party, and then terminates the mute condition in the

21 handset in response to the absence or end of data transmission from a

22 switching office or upon the expiration of a predetermined time period.

23   It is still yet another object of the invention to provide to a first

24 party already engaged in a telephone conversation with a second party

25 an improved method and apparatus which mutes its associated handset

1 during or immediately after generating and transmitting an
2 acknowledgement tone to the switching office, and then terminating the
3 mute condition in the handset after a predetermined period of time or in
4 response to receiving an alerting tone or end of message signal from a
5 local switching office.

6 It is another object of the invention to provide an improved method
7 and apparatus for muting the handset in an apparatus in response to
8 reception of particular data initiated by detection of a start signal word or
9 start bit or pause in an FSK data message from a switching office after a
10 call waiting signal and an acknowledgement signal have been exchanged
11 between the apparatus and the switching office. Further, the mute
12 condition in a handset of the apparatus is terminated in response to a
13 stop bit, stop word, pause, interruption or end of message signal
14 received from the switching office at the apparatus, or alternately, upon
15 the expiration of a predetermined time period after initiation of the mute
16 condition.

17 It is another object of the invention to provide an improved method
18 and apparatus for muting the handset in an apparatus within a
19 predetermined period of time after an acknowledgement signal has been
20 started or sent from an apparatus to the switching office, and for
21 terminating a mute condition in a handset of the apparatus in response to
22 the elapse of a predetermined period of time after the initiation of the
23 mute condition or alternately, in response to receipt of a stop bit , stop
24 signal word, pause, interruption, or end-of-message signal in the FSK
25 data message.

26 It is another object of the invention to provide an improved method

1 and apparatus for muting the handset in an apparatus in response to the
2 occurrence of a carrier signal detection after a call waiting signal and an
3 acknowledgement signal have been exchanged between the apparatus
4 and the switching office and for the terminating the mute condition in a
5 handset of an apparatus in response to the absence of a carrier detect
6 signal by the apparatus for more than a predetermined period of time.

7   It is still another object of the invention to provide an improved
8 call-waiting with caller identification method and apparatus that
9 generates an message received signal back to a local switching office
10 which may be used by the local switching office to terminate a second
11 party mute condition, or for other purposes.

12   It is yet another object of the invention to provide an improved
13 call-waiting with caller identification method and apparatus that
14 compares caller identifying data received against pre-stored data in an
15 apparatus and displays associated data records such as address, city,
16 state or other textual or image information along with, or in place of the
17 caller identification data.

18   It is a further object of the invention to provide an improved
19 apparatus which is capable of receiving, displaying and storing at a busy
20 telephone station of a first party the caller identifying data of a third
21 party while the first party is engaged in conversation with a second
22 party.

23   It is yet another object of the invention to store caller identifying
24 data received after a call waiting tone in a memory of an apparatus and
25 to then announce the data received in human audible form.

1   These and other objects and advantages will become apparent

2   upon review of the detailed specification hereinafter.

3   It is still yet another object of the invention to provide to a first

4   party already engaged in a telephone conversation with a second party

5   an improved method and apparatus which utilizes a notch filter to filter

6   predetermined ACK frequencies from the handset of the first part CPE at

7   least during the ACK signal generation, thereby eliminating the

8   annoyance to the called party from hearing the ACK signal.

9

10

1   ## BRIEF DESCRIPTION OF THE DRAWINGS

2

3   The novel features believed characteristic of the invention are set

4   forth in the appended claims. The invention itself, however, as well as a

5   preferred mode of use, further objectives and advantages thereof, will best

6   be understood by reference to the following detailed description of several

7   illustrative embodiments when read in conjunction with the accompanying

8   drawings, wherein:

9

10   **FIGURE 1** is a block schematic diagram of a telephone subscriber set

11   in accordance with the invention; and

12

13   **FIGURE 2a** is timing diagram illustrating signal timing of some of the

14   embodiments shown in Figures 2b - 2e;

15

16   **FIGURE 2b** is a flow chart describing one embodiment of the

17   invention;

18

19   **FIGURE 2c** is yet another flow chart describing a different

20   embodiment of the invention;

21

22   **FIGURE 2d** is a flow chart describing yet another different

23   embodiment of the invention discussing the comparison of DN data

24   received in a call waiting condition against pre-stored data to display at

25   least one of the DN data and the associated data record;

26

27   **FIGURE 2e** is a flow chart describing another embodiment of the

28   invention discussing the conversion of DN data received in a call waiting

1   condition into audible speech signals;

2

3   **FIGURE 3** is a timing diagram illustrating signal timing of certain

4   embodiments utilizing a frequency notch filter approach;

5

6   **FIGURE 4** is an illustration of the frequency domain that is

7   demonstrative of a frequency notch filter approach for certain embodiments;

8

9   **FIGURE 5** is a block diagram of a preferred embodiment utilizing a

10   frequency notch filter approach;

11

12   **FIGURE 6** is a flow diagram showing operation of a preferred

13   embodiment utilizing a frequency notch filter approach;

14

15   **FIGURE 7** is a depiction of a notch filter.

16

17   **FIGURE 8** is a circuit diagram for an exemplary notch filter.

18

19

1 **DETAILED DESCRIPTION OF THE INVENTION**

2

3 Figure 1 is a block diagram of at least a portion of an apparatus

4 (CPE) necessary to implement the invention. It is recognized that the

5 CPE adapted to implement the inventions herein could comprise a

6 conventional telephone set with integral circuitry, an adjunct call waiting

7 with caller identification display device, a personal computer with a

8 modem, or other devices. It is further recognized that some elements

9 shown in the block diagram are not required for some embodiments of

10 the invention whereas those elements would be included in other

11 embodiments of the invention described in this specification.

12

13 Incorporated herein by reference is the signaling method, format

14 and definition of the messages and parameters as may be utilized in the

15 invention, entitled _Calling Identity Delivery On Call-Waiting_, TR-NWT-

16 000575. Further reference may be made to _Caller Identification With_

17 _Call Waiting: Request For Information From Customer Premises_

18 _Equipment Suppliers_, RFI 91-03; _SPCS Customer Premises Equipment_

19 _Data Interface_, TR-TSY-000030, Bellcore, Issue 1, November 1988; _Call_

20 _Waiting_, LSSGR, Feature Specific Document (FSD) 01-02-1201, TR-TSY-

21 000522, Issue 2, July 1987, _CLASS Calling Name Delivery and Related_

22 _Features Generic Requirements_, TA-NWT-001188, Issue 1, Bellcore,

23 March 1991; and _CLASS Feature: Calling Number Delivery_, TR-TSY-

24 000031, Bellcore, Issue 3, January 1990;.

25

26 In Figure 1 is shown a block schematic diagram of at least a

27 portion of a telephone subscriber set (CPE) necessary to implement the

28 invention.

1   A CPE is coupled to a telephone local switching office (LSO) via a
2   standard telephone connector such as the RJ-11-4 type connector,
3   using pins 3 and 4 coupled to the ring and tip lines of the local switching
4   office (not shown). A line protection circuit (not shown) comprising a
5   varistor and fuse is used to protect against over voltage and over current
6   conditions on the ring and tip lines as is well known in the art. A ring
7   detect circuit (also not shown) may provide alerting signals to a first
8   party that a call has arrived, also well known in the art. The telephone
9   line and line protection circuitry is connected to a 2 wire / 4 wire hybrid
10 circuit 12 along with a hookswitch 13. The hybrid circuit 12 is also
11 connected to a handset 14 comprising transmit and receive transducers
12 15 and 16 respectively.   Hybrid circuit 12 is connected to the
13 transducers 15 and 16 via respective switches 17 and 18 as will be
14 described below.
15

16   The CPE also comprises a control circuit which may be a
17 commercially available microprocessor or controller, a conventional
18 keypad and DTMF (Dual-Tone Multi-frequency) generator 21, and an FSK
19 (Frequency Shift Keying) demodulator circuit 22 that allows for data
20 demodulation and for carrier detection to occur. The microprocessor 20
21 is also connected to a commercially available display 23 which includes a
22 register 24 and visual display unit 25 that may comprise one or more
23 rows each having a plurality of cells 1 to n. Although not shown, display
24 23 may further comprise a touch screen that allows for user input of
25 dialing instructions, scrolling of received and stored caller identifying
26 data, flash, and other functions that are associated with a conventional
27 keypad.
28

1   The microprocessor 20 and the tip and ring leads are also

2 connected to a parallel set detector circuit 26 and a dual tone detector

3 circuit 27.   The parallel set detector circuit 26 functions to provide an

4 output signal that indicates whether or not the CPE of Figure 1 is

5 connected with an off-hook extension set. The dual tone detector circuit

6 27 detects the presence of a dual-tone signal such as a DTMF signal, or

7 may be capable of detecting other non DTMF signals when appropriate

8 or necessary.

9

10   A ring detect circuit monitors the ring and tip lines and outputs a

11 signal to microprocessor 20 when a ring signal is detected on the

12 telephone line. The ring detect circuit is a conventional ring detector

13 circuit that generates a ring signal via an optical isolator, which provides

14 insulation between the CPE and the telephone line.

15

16   The microprocessor 20 responds to signals from the ring detect

17 circuit, the circuits 22,26,27, off-hook switch detector 33, hookswitch

18 13, the keypad 21, and others to provide control signals to the muting

19 switches 17 and 18, the DTMF generator 21 and the display 23.

20

21   As one example of a preferred embodiment contemplated by this

22 inventor, at least one of microprocessor 20, ACK signal generator, and

23 DTMF generator 21 is responsive to a manual switch on keypad 21 or other

24 separate dedicated switch for a "Do not Disturb" feature, which will now be

25 briefly described that selectively prevents the call waiting cycle from

26 occurring upon receipt of a call waiting signal.

27

28   When a first party places to, or receives a telephone call from, a

1   second party, it may be desirable to not be disturbed by a call waiting

2   cycle for that particular call. By manually selecting the "Do not Disturb"

3   switch either before the placement of an outgoing call, prior to

4   answering a first incoming call or during a current call with a second

5   party, at least one of the ACK or DTMF signal generator, the detection of

6   an extension off-hook condition, or microprocessor detection of the

7   presence or absence of an off-hook condition prior to receipt of a call

8   waiting signal is prevented, disabled or otherwise disregarded should a

9   CAS or call waiting signal be received during conversation between the

10   first and second party. By inhibition of an DTMF or ACK signal

11   generation or of the microprocessor checking the status of an extension

12   telephone off-hook condition, because of the selection of the "Do not

13   disturb" switch, a mute condition cannot occur at the first party CPE.

14   This is a great advantage in that there would not be an interruption of

15   conversation between the first party and the second party at an

16   inconvenient time. In some systems, if the LSO has not muted the

17   second party from conversation with the first party until an ACK signal

18   has been received by the first party CPE, the first party and second party

19   would then be able to continue conversation with minimal interruption.

20   This further illustrates the importance of the invention herein in which

21   the mute condition is not created in response to receipt of a call waiting

22   signal. As described in detail in some embodiments in this specification

23   as an advance over the prior art, the mute condition is initiated in

24   response to detecting that there is no extension off-hook and upon the

25   generation of an ACK signal.

26

27   The FSK demodulator 22 includes means for carrier detection as

28   shown in data path 31 to microprocessor 20 that is capable of

1 determining when an incoming data signal is present before actual
2 receipt of the data portion corresponding to the DN of a third party. The
3 FSK demodulator 22 also decodes FSK signals from the LSO and
4 transfers data received via data path 32 to microprocessor 20, comprised
5 of information such as the name, telephone number, date and time, and
6 other   information of the third party for storage, display, redial,
7 annunciation or comparison.
8
9 Keypad and DTMF generator 21 allows for control of the display of
10 stored caller identification or other information, dial or redial instructions,
11 ACK tone generation, selection of operating modes, and other functions.
12
13 Dual-tone detector allows for detection of traditional call waiting
14 signals from the LSO, and is capable of detecting both single and dual-
15 tones as well as other out-of-band signaling that may have a
16 predetermined duration and protocol as employed by the particular call
17 waiting system.
18
19 The microprocessor 20 in the CPE is aware of the off-hook status
20 of the handset of the CPE as well as the off-hook status   of any
21 extension CPE's connected to the telephone line utilizing parallel set
22 detector 26 and/or input from the off-hook switch detector 33 on the
23 device side of hook switch 13.
24
25 Reference is now made to Figure 2a for a description of the timing
26 diagram which depicts various methods for muting of the handset
27 according to the invention herein which will stand in contrast to the prior
28 art.

1   Shown is a timing diagram which starts from left to right, with
2   various time intervals identified as t 0 through t 9 which will now be
3   described.

4   The discussion will first address the typical prior art timing as
5   depicted in M5 and M6. The time interval t 0 is the time during which a
6   third party call is received at the LSO and also is the time before a call
7   waiting signal is delivered to an in-use line between a first and a second
8   party. It is during this interval that, upon receiving a call request from a
9   third party to a first party, the call processor of the LSO executes a call
10   processing software program associated with a call waiting feature and
11   transmits a predetermined dual-tone signal (call waiting tone) to the first
12   party apparatus engaged in a conversation with a second party. In the
13   case of the prior art, the dual tone call waiting signal is typically muted
14   from the second party by the LSO prior to transmission of the call
15   waiting tone to the first party as also shown in M5 of Figure 2a. This
16   LSO controlled mute condition of the second party is initiated to allow for
17   transmission of any caller identifying data of the third party to the first
18   party apparatus without annoying the second party with audible sounds
19   or transferring information from modem transmission, and lasts for a
20   predetermined period of time. The transmission of the call waiting signal
21   occurs as shown in time period t 1 and may last from 100 - 300
22   milliseconds in duration and is typically comprised of a dual tone of 2130
23   Hz and 2750 Hz transmitted on the telephone line to the first party CPE.

24   In response to receiving a call waiting signal from the LSO, the
25   CPE mutes its' associated handset via a microprocessor for a
26   predetermined period of time after the call waiting signal has been
27   detected by a DTMF detector during t 1 as shown in M6. Then a

1 determination is made as to whether any extension telephone set is off-
2 hook in t 2.

3

4 In the prior art systems, after a determination has been made by
5 an off-hook detector that no extension telephone is off-hook in t 2, an
6 acknowledgment signal (ACK) is generated by a DTMF generator in t 3 to
7 inform the LSO that the CPE is ready to receive data after a mute
8 condition for a predetermined period of time has been initiated at the first
9 party CPE by the microprocessor. If an extension telephone is
10 determined to be off hook in t 2, then the prior art systems inhibit
11 generation of an ACK signal back to the LSO, and the data transmission
12 is terminated from the LSO to the CPE. The microprocessor in the first
13 party CPE inhibits any acknowledgement tone generation in t 3 to
14 prevent the local switching office from further transmitting FSK data that
15 could be annoying to other parties on an extension at the first party
16 location that do not have the handset muted on their telephone.

17

18 In any case, after the expiration of a predetermined period of time
19 at the LSO, the second party mute condition is terminated as shown in
20 M5. The first party mute condition also must continue for the
21 predetermined period of time at the first party CPE and then is terminated
22 as shown in M6. Then, once both the first and second party
23 predetermined period of time for the mute condition has elapsed,
24 conversation can continue between the first and second party as before
25 the call waiting tone was received. Typically, the expiration of the
26 predetermined period of time for the first party and the second party
27 occurs sometime after the longest time allowed for data transmission
28 shown in t 7 and depicted in M5 and M6.

1

2   If no extension telephone is off-hook, then the apparatus sends an

3   acknowledgement tone back to the LSO as shown in t 3 which is

4   typically 50-100 ms in duration. This is sent after a period of time has

5   elapsed in t 2 and is sent during a very quiet period of time since both

6   the first and second party have been muted.

7

8   Upon receipt of the acknowledgment tone from the CPE, the LSO

9   sends logical 1 data during t 5 to condition an FSK demodulator to

10   receive the DN (caller identifying data) of the third party to the CPE, as

11   then received in t 6 and t 7.

12

13   In t 6 and t 7, the apparatus receives the DN data, which is

14   translated into digital bit stream data and sent to a microprocessor in the

15   CPE, which translates the data into information that can be viewed on a

16   screen. Then the first party can know the identity or other information

17   of the third party and decide whether to take the call. Finally, in t 8,

18   after the expiration of a predetermined period of time at the LSO and at

19   the first party CPE, the mute condition is terminated for the first and

20   second parties and conversation can be resumed.

21

22   Discussion will now address various embodiments according to the

23   invention as represented in M1, M2, M3, and M4. Other adaptations

24   according to the invention are not specifically shown for sake of brevity

25   but it should be recognized that they could be implemented in keeping

26   with the spirit of the invention herein.

27

28   When characterized as a method, the present invention is directed

1   to muting the handset in a CPE in a manner that minimizes the period of

2   time that a first and a second party cannot communicate. The method

3   comprises a number of steps.

4

5   First, in response to a calling signal from a third party as in t 0, a

6   local switching office sends a call waiting signal to a first party CPE as

7   shown in t 1, when the first party is engaged in conversation with a

8   second party. At this point, utilizing a conventional call waiting system,

9   the second party mute condition could be initiated by the LSO as is

10   conventionally done, before the generation of the call waiting tone to the

11   first party, although it is recognized that it could occur at some other

12   time up to the occurrence of data transmission at t 5 to facilitate full use

13   of the invention herein. The inventive methods described herein could be

14   utilized and coexist in a conventional call waiting system transparent to

15   the end user if desirable. Or, the inventive methods described herein

16   could also be utilized in a modified, non-conventional call waiting system

17   that would minimize the total muted time between a first and second

18   party.

19

20   In response to receipt of the call waiting tone at the first party

21   CPE, a microprocessor generates an ACK signal back to the switching

22   office as shown in t 3. Various higher or lower signaling frequencies

23   within the voice band may be used instead of DTMF that could be heard

24   briefly by the first party without deleterious affect because of the short

25   duration required to affect signaling. In addition, the ACK signal could

26   be generated immediately upon detection of the call waiting tone to

27   minimize the total time required to establish communication between the

28   LSO and the CPE. Effectively, it is feasible that time period t 2 would

1   not be required in some implementations and that the first party would

2   hear both the call waiting signal and the ACK signal as one signal

3   because of the generation timing.

4   Upon receipt at the switching office of the acknowledgment signal

5   generated by the CPE, the switching office transmits data back to the

6   called party CPE as in t 5 that is conventionally logical 1 data and

7   additional FSK (Frequency Shift Keyed) data that is representative of the

8   identity of the third party as in t 6 and t 7.

9   Shown in M1 is a timing diagram according to one embodiment of

10 the invention in which the CPE microprocessor initiates a mute condition

11 of its' handset simultaneous or during the generation of an ACK signal

12 back to the LSO. In this embodiment, the CPE is then ready to receive

13 data when the LSO transmits data in response to receiving the ACK

14 signal, as shown in t 5. In this case, the first party will usually not hear

15 the ACK signal as the handset is muted upon generation of , or

16 immediately after initiation of, the ACK signal by a ACK signal or DTMF

17 signal generator.

18   The microprocessor in the first party CPE can initiate a

19 predetermined time period to continue the mute condition as measured

20 against the termination of the call waiting signal at the end of t 1, the

21 initiation or termination of the ACK signal (the beginning or end of t 3

22 respectively), or the receipt of the first bit of data in the DN caller

23 identifying data received as in t 6 or by some other known time

24 reference. Alternatively, the microprocessor in the first party CPE may

25 terminate the muted condition as a result of receiving a stop bit or signal

26 word at the end of t 6 or t 7, and/or after a carrier signal has not been

1 detected for more than a predetermined period of time. This has

2 significant advantages over the prior art in that the mute condition only

3 need occur in the CPE for so long as data transmission is actually

4 occurring, thereby allowing the first party and the second party to

5 resume conversation as soon as possible. In t 9 is shown an optional end

6 of message signal that may be generated by the DTMF generator under

7 control of the microprocessor in the CPE. This end of message signal is

8 generated after the microprocessor has determined that no more data is

9 being received in an automatic fashion from the FSK decoder and may be

10 received by the LSO to indicate successful reception of the DN data.

11 Alternatively, the end of message signal can be manually initiated by a

12 key selection by the first party. The LSO can then terminate the second

13 party mute condition immediately upon receipt of the end of message

14 signal rather than wait for a predetermined period of time to occur. As

15 an alternative use of this information, the LSO may transmit back to the

16 third party an acknowledgment signal or message that the called party

17 has received a call waiting notification and wishes to speak with them

18 shortly after terminating the current conversation with the second party.

19   The third party can then know to remain on the line without the first

20 party having to speak to them.

21   Shown in M2 is a timing diagram according to another

22 embodiment of the invention in which the CPE has initiated a mute

23 condition in response to the microprocessor determining that the ACK

24 signal generation has been completed. In this embodiment, the first

25 party hears the entire ACK signal prior to the initiation of a mute

26 condition. As discussed previously, the second party may or may not be

27 muted at this time, depending upon the particular determination made at

1   the LSO. For example, the LSO may elect to only initiate the mute

2   condition after successfully receiving an ACK signal from the first party

3   CPE. In one embodiment envisioned, the LSO could generate two

4   different and distinctive tones to alert a call waiting condition. The first

5   party CPE could receive a conventional call waiting tone that would

6   cause a suitable ACK signal to be generated. The second party, not yet

7   muted by the LSO, could receive a second different tone from the LSO

8   that would not cause their CPE to initiate an ACK signal but would still

9   alert the second party that a call waiting condition was occurring and

10   that they would be muted by the LSO for a short period of time. This

11   could also occur simultaneous with the initiation of a mute condition.

12   Time period M3 shows another embodiment according to the

13   invention herein in which the CPE of the first party utilizes a carrier signal

14   detection circuit to detect the presence of data transmission from the

15   LSO during time period t5 and then initiates a mute condition. It is

16   realized that the period of time to detect a carrier signal is approximately

17   25 - 50 ms before the mute condition would be initiated for the first

18   party. After the microprocessor has been notified by a suitable carrier

19   signal detector, such as the Motorola Model MC 145447 or other

20   suitable FSK and carrier signal detectors / decoders, that the presence of

21   carrier signal has been detected, a mute condition can be initiated in the

22   first party CPE handset. The mute condition would be initiated with the

23   detection of a carrier signal as in t 5, and then terminated after the

24   expiration of a predetermined period of time.

25   Time period M4 shows yet another embodiment according to the

26   invention herein. In this embodiment, the mute condition is initiated at

27   the end of the carrier signal immediately preceding the start of the data

1   portion of the FSK transmission from the LSO to the CPE. As previously

2   described, the termination of the mute condition could be dynamically

3   adjusted to the length of the message received, could be responsive to

4   receipt of a particular stop bit or stop signal word, or could be in

5   response to a predetermined time period.

6   Time period t 6 data transmission is comprised of a ten digit

7   telephone number and typically lasts for approximately less than 1

8   second in a 1200 baud system with 8 bit encoding although it is

9   recognized that this transmission time could be reduced with higher

10 modem speeds or different data encoding schemes.   Time period t 7

11 allows for other data including name, time and date data and can be

12 variable in length, depending upon the identity of the third party as sent

13 by the LSO. For this reason, it is most efficient for the termination of the

14 mute condition in the first party CPE to occur in response to the end of

15 data transmission rather than according to a static predetermined period

16 of time.

17   It is recognized that other data transmission protocol could be

18 utilized instead of FSK signaling without departing from the spirit of the

19 invention.   Assuming FSK data transmission, an FSK decoder receives

20 the FSK signals and outputs the caller information in digital logic voltage

21 levels to a microprocessor in the CPE. The handset is muted in response

22 to receipt of the FSK data so that the called party will not be annoyed by

23 audible sounds created by the FSK signaling. The muting of the handset

24 is initiated by the microprocessor by employing several different methods

25 as previously described.

26   Time period t 8 can allow for the circuits at both ends to prepare

1   to resume normal operation and in time period t 9, an optional end of

2   data signal can be generated by a DTMF or other signal generator to

3   notify the LSO that the data was successfully received by the CPE. The

4   LSO may optionally also use this end of data signal received from the

5   CPE to terminate the mute condition of the second party, rather than

6   relying on a static predetermined period of time as is conventionally

7   done.

8   The operation of the circuit and invention herein will now be

9   explained using Figure 2b in conjunction with Figure 1. It will be

10   assumed that a first party using the CPE shown in Figure 1 is conversing

11   with a second party via the LSO and that a third party is attempting to

12   reach the first party.

13   In block 101, the local switching office (LSO) sends a call waiting

14   tone, after receiving a call request from a third party, to a CPE of a first

15   party engaged in conversation with a second party. As described

16   above, this call waiting tone is preferably a dual-tone comprised of a

17   2130 Hz and a 2750 Hz signal but could be comprised of any other

18   signal that could be reliably detected in the presence of voice and used

19   in a conventional call waiting system.

20   In block 102, in response to receiving a call-waiting tone by dual

21   tone-detector 27, the CPE checks to see if there is an extension

22   telephone off-hook using parallel set detector 26 or hookswitch detector

23   or connection 33. If there is an extension telephone off-hook as in block

24   103, microprocessor 20 prevents the generation of an ACK signal by not

25   using DTMF generator 21. As a result of not receiving the ACK signal at

26   the LSO, the DN of the third party is not sent to the CPE and the second

1   party mute condition expires at the LSO. Then the first and the second

2   party conversation is enabled as before receipt of the call waiting signal.

3

4   If there is no extension telephone in an off-hook condition as

5   detected by parallel set detector 26 or hookswitch detector 33, then the

6   CPE sends an acknowledgement tone (typically DTMF) back to the LSO

7   as in block 104 using microprocessor 20 and DTMF generator 21 to

8   notify the LSO that the CPE is ready to receive.

9   After the transmission of the ACK signal by DTMF generator 21,

10   the microprocessor 20 also readies FSK demodulator 22 to receive data

11   and waits for receipt of a carrier detect signal as indicated in connection

12   31 between FSK Demodulator 22 and microprocessor 20.   After

13   detection by a carrier detection circuit of a long enough mark or space in

14   the data transmission, the microprocessor 20 can then proceed to block

15   105. It should be recognized that data path 31 is shown between FSK

16   Demodulator 22 and microprocessor 20 to logically distinguish the

17   detection of a carrier signal from the actual caller identifying data

18   presented on data path 32. The carrier detection could be performed by

19   the FSK Demodulator 22 and transmitted to the microprocessor 20 via a

20   separate data path 31, or could be performed using the FSK Demodulator

21   33 and transmitted to the microprocessor 20 via the same data path 32

22   as utilized for the transmission of other caller identifying data. It is

23   further anticipated that FSK Demodulator or microprocessor could

24   employ a comparing means such as seen in comparator 29 or via an

25   integral comparing means (not shown) to compare a presorted start

26   signal word with the initial data received from the LSO. Unique data such

27   as logical 1 or logical 0 that was received in the preamble of the FSK

1   data transmission for longer than a predetermined period of time could

2   cause a carrier detect signal to be transmitted via data path 31 to the

3   microprocessor 20.   In the case of an occurrence of a coincidence

4   between the header data received from the LSO and the prestored data

5   or parameters or logical mark or space for more than a predetermined

6   period of time, the microprocessor would initiate a mute condition.

7   In any case, after determining carrier detection or a particular start

8   signal bit or word or other data coincidence detection, in block 105 is

9   shown that the microprocessor 20 then initiates a mute condition by

10   opening relays 17 and 18 connected to transmitter 15 and receiver 16

11   respectively utilizing the connection labeled "MUTE".   This mute

12   condition occurs in response to the detection of a carrier signal or other

13   conditions as described earlier in data path 31 and before the DN data

14   transmission has occurred.

15   After the mute condition has been created by the microprocessor

16   20 in response to a carrier or start signal detection, the FSK Demodulator

17   22 then receives additional data from the LSO over the telephone line

18   which contains information corresponding to the DN of the third party.

19   Typically this data is formatted using frequency shift keying although it is

20   recognized that other data transmission protocol could be used without

21   departing from the spirit of the invention.   Other data types would

22   require a suitable decoder unit to decode and transmit information to the

23   microprocessor.

24   As is done conventionally, the FSK data is decoded by FSK

25   Demodulator 22 and converted as a digital bit stream via data path 32 to

26   microprocessor 20 as in block 107.   Microprocessor 20 then translates

1   that data into information that is transferred to register 24 and displayed

2   on display 23 as in block 108. The subscriber is then in a position to

3   decide whether or not to accept the waiting call based on the identity of

4   the caller. Acceptance of the waiting call is accomplished in the

5   conventional manner with depression of a flash button on the CPE

6   whereas rejection of the waiting call is accomplished by ignoring it.

7   Then in block 109, the handset 14 in the CPE device is unmuted by

8   microprocessor 20 by restoring switch contacts 17 and 18 to a closed

9   condition and the first party may resume conversation. This may occur

10   in several different ways. In one approach, the microprocessor starts a

11   timer means starting as measured against generation of the

12   acknowledgement signal or receipt of data from the LSO. In another

13   approach, the FSK signal demodulator 22 responds to the absence of

14   carrier signal data for more than a predetermined period of time and then

15   notifies microprocessor 20 that there is no more data being received. In

16   a third approach, the FSK Demodulator 22 receives a specific logical data

17   mark or pause or stop bit which is demodulated and transmitted to the

18   microprocessor.

19   In any case above, after the occurrence of the expiration of

20   predetermined period of time from a known event, lack of detection of

21   carrier signal from the LSO and telephone line for more than a

22   predetermined period of time by the FSK Demodulator 22 and

23   microprocessor 20, or receipt of a specific stop bit or word or pause, the

24   handset 14 in the CPE is restored to an unmuted condition and

25   conversation can occur between the first and second parties in a more

26   efficient manner.

27   This acknowledgment signal may or may not be heard by the first

1 party, depending upon when the CPE initiates a mute condition. The
2 DTMF acknowledgement tone will comport with the frequency and
3 duration required by the specific call waiting system and may
4 immediately follow the call waiting tone received by the LSO.

5   In conventional call waiting systems, the second party cannot hear
6 either the call waiting signal or the acknowledgment signal for a
7 predetermined period of time, although the first party may still hear the
8 acknowledgment signal.   In modified call waiting systems, conversation
9 may still occur between the first and second parties over this
10 acknowledgment signal when the second party has not yet been muted
11 from the switching office. Furthermore, as mentioned earlier, the second
12 party apparatus may be responsive to the ACK signal and initiate a mute
13 condition.

14   In block 105 is shown how the CPE mutes its' associated handset
15 in response to the determination that the ACK signal has been sent. In
16 this case, where the first party handset is not yet muted, the call waiting
17 tone will sound like a slightly longer call waiting tone than usual (perhaps
18 no more than 50 ms longer). The call waiting tone received from the
19 LSO is immediately followed by the ACK tone generated by the CPE,
20 both which are heard by the first party in this case.

21   In an alternative embodiment, the CPE may mute the handset
22 simultaneous with, and caused by, the generation of an ACK tone to be
23 sent to the LSO.   This embodiment may be implemented by
24 microprocessor control in the CPE when it is desirable for the first party
25 to not hear the ACK tone transmission. Equipment manufacturers will
26 find this option as an additional feature that may be desirable to make

1   the operation and user interface more consistent with conventional call

2   waiting telephone sets that do not allow the first party to hear the ACK

3   tone. This feature has the added advantage of minimizing the period of

4   time the mute condition occurs in conventional call waiting systems in a

5   manner that is totally transparent to the first and second parties and

6   consistent with the interface of other competing equipment.

7   In block 104, the CPE generates an ACK tone back to the LSO

8   after a determination is made that no extension telephone is off-hook,

9   and then in block 105 the CPE mutes its' associated handset after the

10   ACK tone has been generated. In this case, the mute condition is

11   caused prior to receipt of the DN data from the LSO.

12   Alternatively, the handset is muted at the CPE while an ACK tone

13   is generated back to the LSO in block 104 at substantially the same time,

14   and the CPE is made ready to receive DN data from the LSO.

15   In block 106, the LSO sends the DN (caller identification) data of

16   the third party utilizing FSK data as is known in the art. In block 107,

17   the CPE receives the DN data after the mute condition has been initiated,

18   stores and displays the DN data received for the first party, as in block

19   108, and terminates the mute condition as in block 109.

20   The mute condition may be terminated in response to receipt by

21   the CPE of an end of data flag contained in the FSK data transmission.

22   Alternatively, the mute condition may elapse after the expiration of a

23   predetermined period of time as measured from when the ACK signal

24   was first sent or when the mute condition was first initiated. In another

25   approach, the mute condition may be terminated by the detection of the

26   absence of a carrier signal from the LSO to the CPE that lasts for more

1   than a predetermined period of time.

2   After the handset is returned to an unmuted condition of operation
3   in block 109, the first party may resume conversation with the second
4   party after the time period for the second party mute condition has
5   expired at the LSO. Typically the LSO initiates the mute condition for a
6   predetermined period of time when the call waiting signal is sent to the
7   first party, after which the second party is then returned to a non-muted
8   condition.

9   An additional function not shown may be alternatively
10   implemented in which the CPE can generate an end of data signal for
11   transmission back to the LSO at the end of receipt of the DN data. This
12   data signal generation may be received by the LSO and used to
13   terminate the mute condition of the second party immediately at the end
14   of transmission of the DN data.

15   This could be a useful feature in that the second party could be
16   more readily returned to communication with the first party, rather than
17   having to wait for a predetermined period of time to elapse as
18   determined by the LSO. This would enable the first and second party to
19   resume communication more readily than is currently permitted. In the
20   case where the DN data was of variable length, the first and second
21   parties would only be interrupted by a mute condition for the amount of
22   time necessary to transmit the DN data in the improvement discussed
23   without having to wait for the expiration of a predetermined, non-variable
24   length of time to elapse at the LSO.

25   In one approach, the microprocessor in the CPE causes the
26   handset to mute in response to the elapse of a predetermined period of

1   time after the acknowledgement signal is sent by the CPE to the

2   switching office. A time counter means within the microprocessor

3   initiates a mute condition within a predetermined period of time after the

4   generation of an acknowledgement signal, and then terminates the mute

5   condition of the handset after expiration of the predetermined period of

6   time. This time period can be adjustable according to the signaling

7   protocol employed, the speed of data transmission, and the type of data

8   being transmitted from the switching office.

9   In another approach, the microprocessor in the CPE causes the

10   handset to mute in response to the receipt of a start bit or start message

11   word contained within the FSK data transmission from the switching

12   office. Upon detection of the start bit or start message word, the

13   microprocessor causes a mute condition in the handset of the CPE while

14   FSK data transmission occurs from the switching office. Additionally,

15   the microprocessor may employ a timer means that will continue the

16   mute condition for a predetermined period of time, and then will cause or

17   allow the handset to return to a non-muted condition. Alternatively, the

18   microprocessor can hold the muted condition until such time as a stop bit

19   or stop message word is received in the FSK data transmission.

20   In another approach, the microprocessor in the CPE can employ a

21   carrier detection circuit which senses the presence of a data transmission

22   signal from the switching office to terminate the mute condition shown in

23   block 109. The carrier detection circuit can be used to initiate a mute

24   condition upon the sensing of the presence of data from the LSO to the

25   CPE, and can then be used to terminate the mute condition for the

26   handset of the CPE after a predetermined period of time beyond which

27   no data transmission has been detected.

1   After the carrier detection circuit determines that no other data is

2   being transmitted to the CPE from the LSO, the microprocessor returns

3   the handset to a non-muted condition and the first and second party are

4   allowed to resume conversation. Alternatively, a timer means can also

5   be started upon the initiation of the mute condition by the carrier

6   detection circuit which causes the mute condition to be terminated after

7   the elapse of a predetermined period of time.

8

9   It is further contemplated that non-audible signaling could be

10   employed by the switching office to initiate the call waiting notification

11   to the CPE. In response to detection by the CPE of the non-audible

12   signal from the switching office, an audible tone could be generated by

13   the CPE that would serve both as an acknowledgment tone back to the

14   switching office, and as the first audible notification to the first and

15   second parties that a third caller was attempting communication. In the

16   mean time, conversation between the first and the second party would

17   be uninterrupted during the time period when a call waiting tone would

18   be ordinarily heard. Alternatively, an out-of-band call-waiting signal from

19   the switching office or an out-of-band acknowledgment signal generated

20   by the CPE could also trigger a display message such as "Incoming Call"

21   or could initiate a flashing light or displayable icon within the CPE. This

22   would be beneficial in that the first party would be alerted to a call-

23   waiting condition without the second party being aware of another party

24   attempting communication.

25   Shown in Figure 2c is another embodiment according to the

26   invention. First, in block 201, the LSO sends a call waiting signal to the

27   first party CPE. Further, the second party speech path is muted from the

1   second party and the first party by the LSO to prevent the second party

2   from hearing any data transmission from the LSO to the first party that

3   may occur. In block 202, a determination is made as to whether or not

4   an extension telephone is off-hook. If an extension telephone is off-

5   hook, then in 203 an ACK signal is not generated, and as a result of not

6   receiving the ACK signal, the LSO prevents the DN information from

7   being transmitted to the first party CPE and the second party mute

8   condition expires or is terminated at the LSO. Then the first and second

9   party may resume conversation as before the call waiting signal.

10   If an extension telephone is not off-hook as determined in block

11 202, then in block 204 the CPE sends a suitable ACK tone for receipt at

12 the LSO. In block 205, after receiving the ACK tone from the CPE, the

13 LSO sends FSK data that includes the DN of the third party. In block

14 206, the CPE employs a carrier detection circuit to sense the presence of

15 data being transmitted from the LSO to the CPE.

16   In this embodiment, no particular data signal is detected but

17 rather, any carrier data transmission from the LSO as detected by the

18 carrier detection circuit in the CPE will cause a mute condition at the first

19 party CPE to occur before receipt of the remaining data transmission.

20 With the mute condition being established, the CPE is then ready to

21 receive the remaining data, which includes DN data.

22   In block 208, the CPE receives the DN data, stores and displays

23 the data in block 209, and terminates a mute condition in 210 as

24 previously described.

25   Alternatively, the method may employ an implementation not

26 shown in which an end of message or message received signal may be

1   generated back to the LSO as also previously described to eliminate an

2   unnecessarily long muted condition for the second party and to alert the

3   third party that the message has been received by the first party. As

4   previously described, this could occur automatically under the control of

5   a microprocessor, or by manual selection by the first party by a key

6   selection at the CPE.

7   In Figure 2d is shown another alternative embodiment according to

8   the invention. In block 301, the LSO sends a call waiting tone to the

9   CPE of the first party. Upon receipt of the call waiting tone, the CPE

10   checks to see if an extension telephone is in an off-hook condition, as in

11   block   302.   If   an   off-hook   condition   is   detected,   then   an

12   acknowledgment tone is not sent by CPE to the LSO, and the operations

13   previously described in Figure 2c then occur.

14   Alternatively is shown in block 316 where in response to detection

15   that an extension telephone is off-hook, a different signal, referred to as

16   an "unmute" signal may be sent to the LSO that will terminate the

17   second party mute condition and will immediately allow the second party

18   to resume conversation with the first party. It is recognized that although

19   this feature may be useful, it is not necessary or fundamental to the

20   invention herein.

21   In the case where an extension telephone is not off-hook as

22   determined in block 302, the CPE sends an ACK signal to the LSO in

23   block 304. Then in block 305, in response to receiving the ACK signal

24   sent in block 304, the LSO sends an FSK signal containing DN data to

25   the CPE. Then, a carrier detection circuit is employed by the CPE to

26   sense the presence of a data transmission from the LSO in block 306,

1 and the CPE initiates a mute condition in block 307. Then the data

2 transmission continues in block 308 where the CPE receives the DN data

3 of the third party. In block 309, the CPE stores the DN data received.

4   In an alternative embodiment, the CPE receives data from the LSO

5 in 305, and detects a specific data bit, signal, or word which is

6 contained in the FSK transmission that precedes the DN information, in

7 block 306, and then initiates a mute condition in block 307. Then in

8 block 308 the DN data is received and then stored as in block 309.

9   In any case after block 307 with the initiation of the mute

10 condition, the CPE either automatically, or in response to a first party

11 selection, compares the DN data received with other data previously

12 stored using a comparator and memory in the CPE as in block 310, and

13 at least one of either the DN data received or the prestored matching

14 data is displayed. The CPE may terminate a mute condition in 312 either

15 before or after the DN data has been applied to a prestored directory and

16 displayed. Reference is made to U.S. Patent 4,924,496 issued to Figa et

17 al. for further discussion related to this feature. It is anticipated that the

18 comparison feature will be widely popular for so called "screen pop"

19 applications for personal computer based telephony in the future.

20   In Figure 2e is shown another embodiment in which DN data

21 received may be at least one of displayed and announced to the first

22 party before termination of a mute condition from the second party.

23 Alternatively, data received may be displayed to a first party, and

24 selectively announced to both the first and second party, as determined

25 by the first party preference. In another alternative embodiment, the

26 data received may be announced to both the first and second party after

1   the termination of the mute condition, which may be of benefit to first

2   parties who wish for the second party to know the identity of the third

3   party to determine if a conference call should be initiated, or for other

4   purposes. This embodiment is uniquely adapted to the needs of visually

5   handicapped persons. The CPE may terminate the mute condition of its'

6   handset at any time after receipt of the DN data in any of the

7   embodiments described herein.

8   In block 410, after receipt of the DN data, the CPE may employ a

9   text-to-speech processor to textual data received to annunciate the data

10 in a human recognizable form to at least one of the first and second

11 parties, either immediately, or at some later time selected by the first

12 party.   Directory numbers and/or names received as logic signals in a

13 microprocessor from an FSK demodulator are processed by a speech

14 generator that may be integral to the microprocessor, or may be separate

15 discrete circuitry attached to the microprocessor and may be converted

16 into audible speech signals.   Further, it is anticipated that this

17 information could be remotely retrieved by a first party that was not

18 present and was calling in for messages.

19   The data could be applied to a comparator as previously described

20 in block 410 and prestored sound data could be generated, or associated

21 other data could also be applied to a text-to-speech processor. As in

22 Figure 2d, the CPE could terminate the mute condition in Figure 2e as

23 shown in block 411 before or after the DN or other data was either one

24 of displayed or announced.

25   Further adaptations could be implemented according to the

26 invention herein. For example, the various embodiments and apparatus

1   described hereinbefore could include a means for determining that after a

2   predetermined period of time that a call waiting signal was received, if no

3   further data was detected from the local switching office by the first

4   party apparatus (CPE), a mute condition would be terminated at the first

5   party apparatus responsive to the expiration of the predetermined period

6   of time.

7   This is particularly adapted to the methods and devices described

8   earlier in which a mute condition is initiated in response to generation of

9   an acknowledgment signal, or in the case where the mute condition of

10 the first party apparatus occurs after the expiration of a predetermined

11 period of time after receipt of a call waiting signal. Upon determination

12 that no DN data was being received within a predetermined period of

13 time as described earlier, the mute condition could be terminated sooner

14 than waiting for the time period that would ordinarily be used for data

15 transmission.   This would allow a first party and a second party to

16 communicate more readily than in prior art systems.   It may also be

17 beneficial for a call waiting signal to be only sent to a first party if it was

18 determined to be flagged as public by the local switching office. In the

19 case where a DN of a third party was private, depending upon the level

20 of service desired by the first party subscribing to call-waiting service, no

21 call-waiting signal would be sent from the LSO to the first party CPE and

22 a second party mute condition would not be initiated for a second party.

23 In this way, a first party conversing with a second party would only be

24 interrupted by call-waiting signals and mute conditions when there was

25 DN data that would be useful for the first party.   In effect, it is

26 anticipated that a new system could be implemented that would

27 effectively "screen" call waiting signals and mute conditions from

1   occurring unless there was DN data present.

2   It is further anticipated that upon generation of an
3   acknowledgment signal by the first party apparatus or CPE, a timer
4   means could be employed which could start a mute condition in response
5   to expiration of a predetermined period of time after generation of the
6   acknowledgment signal.

7   Finally it is anticipated that, in the case where the CPE apparatus
8   initiates a message received signal back to the LSO after receiving the
9   caller identifying data of a third party, the LSO could use this information
10   to terminate a mute condition of a second party more readily to allow for
11   the first and second party to communicate sooner.

12   Notch Filtering used in one preferred embodiment to filter ACK
13   signals from the handset or speaker.

14   In Figure 3 is shown a timing diagram illustrating several preferred
15   embodiments utilizing an approach in which a notch filter is implemented
16   to exclude a particular frequency or frequencies from being heard at the
17   handset of a called party CPE or being transmitted via the microphone at
18   the handset of a called party.

19   Typically, in the prior art approaches, sound output to the CPE
20   handset earpiece was completely muted in response to receipt of a call
21   waiting signal (CAS tone) to initiate a quiescent period for receipt of
22   caller id data and to insulate the called party from the sound of the ACK
23   signal generation. In another prior art approach, the sound volume in the
24   handset earpiece was attenuated to minimize distraction to the called
25   party due to hearing the ACK signal. In either case, both approaches

1   nearly eliminated the possibility of having any useful communication or

2   exchange between a called party and a first caller.

3   The first caller is typically muted by the LSO when a call waiting

4   condition occurs which thereby precludes any communication with the

5   called party during the call waiting cycle. However, the notch filter

6   approach described herein could enable the possibility of longer

7   communication between the called party and the first caller if the timing

8   of the mute condition imposed by the LSO to the first caller were

9   modified to occur slightly later than it does currently. By minimizing the

10   duration of the mute condition created at the LSO for the first party, the

11   notch filter approach or the other approaches described in this

12   specification could facilitate longer communications between a called

13   party and a second party during the call waiting cycle.

14   Certainly in any case, the notch filter approach could be useful in

15   providing a more efficient manner to insulate the first party from the

16   annoyance of the sound of the ACK signal generation without any

17   modification to the current call waiting service or system.

18   The filtering of the ACK signals from the called party CPE handset

19   in one preferred embodiment is initiated either in response to the

20   detection of, or at a time relative to the detection of, receipt of a CAS (

21   call waiting) tone or signal from the local switching office. In another

22   preferred embodiment the filtering of the ACK signal is initiated

23   simultaneous with, at some time after, or at a time relative to, the

24   checking for an extension on-hook condition by the called party CPE. In

25   another embodiment the initiation of filtering of the ACK signal from the

26   called party CPE handset occurs simultaneous with, at some time after,

1 or at a time relative to the generation of the ACK signal. A sample

2 range of timing alternatives is illustrated in FIGURE 3, as shown in M7 -

3 M11.

4   More specifically in one embodiment shown in FIGURE 3, at M7

5 the notch filter is initiated by a microprocessor in the CPE simultaneous

6 with the first detection of the CAS tone, and shown to continue until the

7 termination of the ACK signal generation. The signals comprising the

8 ACK signal are not heard by the first or called party, while all other

9 audible signals may be heard over the handset earpiece and generated

10 over the handset microphone, thereby allowing for voice or other

11 communication to occur until the mute condition is commenced as in

12 M8. In the depicted example, the mute condition is initiated immediately

13 after the ACK signal has been generated, or at some time period related

14 to the termination or initiation of the ACK signal. In this preferred

15 embodiment, the notch filter is in operation only until the end of the ACK

16 signal generation.

17   In another embodiment as shown in FIGURE 3, at M9 the notch

18 filter is initiated by a microprocessor in the CPE simultaneous with the

19 generation of the ACK signal, and allowed to continue until the first

20 detection of data from the LSO, at M10 where the mute condition is

21 initiated at some time prior to receipt of data from the LSO. In yet

22 another embodiment, the notch filter is initiated and allowed to continue

23 in parallel with a later occurring mute condition until the expiration of a

24 predetermined period of time, at a time related to receipt of data from

25 the LSO, at a time related to the detection of the absence of data from

26 the LSO, at the same time or at some time related to termination of the

27 mute condition, at the receipt of a stop bit or in some other manner.

1   In any case, utilizing a notch filter approach, voice
2   communications may be allowed in the called party CPE between the
3   first and second party without the interruption of the conversation or
4   annoyance from the sound of the ACK signal. This may occur because
5   all other frequencies in the voice range can be heard and transmitted at
6   the called party CPE during ACK signal generation until the initiation of a
7   mute condition, with the exception of the frequencies filtered from at
8   least the handset microphone of the CPE or the handset earpiece that
9   comprise the ACK signal (to be transmitted to the LSO). Although in
10   current systems the ACK signal is comprised of a DTMF signal, it is
11   contemplated that such signals requiring filtering could be other voice
12   band, high band or out of band signals.

13   After initiation of the filtering of the ACK signal described
14   hereinbefore, the filtering may be terminated or allowed to continue in
15   parallel with a mute or attenuation condition which has been started.
16   Incorporated herein by reference are US Patents 5,812,649 Shen et al. ,
17   US Patent 5,836,009 Diamond et al. US Patent 5,646,979 and US
18   Patent 5,481,594 Shen et al. which could be modified to incorporate the
19   filtering circuit and methods taught in this invention. The mute
20   condition can be initiated simultaneous with and in response to the
21   termination of the filtering, or in response to a predetermined time
22   period relative to the generation or termination of the filtering. The mute
23   condition in the handset then is terminated as described elsewhere in
24   detail in this patent specification. Likewise, a range of alternatives may
25   allow for the termination of the filtering circuit operation, such as upon
26   the elapse of a predetermined period of time, upon receipt of a particular
27   data bit, upon detection of the presence of a carrier signal, upon

1 detection of the absence of a carrier signal after it has been detected,

2 simultaneous with or related in time to the termination of the mute

3 condition, or related in time to the receipt of a CAS tone or detection of

4 an extension on-hook condition, in any combination applied to at least

5 one of the handset earpiece or the handset microphone.

6   A band-reject filter (also called band-elimination, or notch, filter) is

7 one which passes all frequencies except a single band. The amplitude

8 response of such a filter is shown in Figure 7, where the ideal response

9 is that represented by the broken line, and realizable approximation to

10 the ideal is that represented by the solid line. The band of frequencies

11 which is rejected is centered approximately at w_o and its width is B. The

12 bandwidth B may be measured by Hz, in which case the center

13 frequency is $f_o = w_o/2\pi$ Hz. As in the bandpass case, we also define the

14 quantity Q by w_o/B (or f_o/B if B is in Hz). Thus a large Q indicates a small

15 band rejected, and a small Q indicates a wide band.

16   A second-order approximation to an ideal band-reject filter is

17 achieved by the transfer function

18

$$H(s) = \frac{V_2(s)}{V_1(s)} = \frac{K(s^2 + \omega_0^2)}{s^2 + Bs + \omega_0^2}$$

19

20 where w_o is the center frequency in rad/sec and $B =$ is the width of

21 the band rejected. The gain is defined as the value of $H(s)$ at either zero

22 or infinity and is seen to be K.

23

24

1   A circuit which realizes this is the band-reject circuit shown in Figure 8,

2   an analysis of which yields, if $R_3R_4 = 2R_1R_5$,

3

$$B = \frac{2}{R_4C}$$

4

$$\omega_0^2 = \frac{1}{R_4C^2}\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

5   We may obtain a practical realization of the band-reject filter of Figure 8,

6   for given values of center frequency f_0 Q, and gain.

7   In FIGURE 4 is shown a graphical depiction of how the notch filter

8   approach provides for exemplary data or voice transmission during the

9   ACK signal generation. Note that in the Chaput approach, all voice or

10   data communication is muted from the earpiece during the call waiting

11   cycle for a predetermined period of time, initiated in response to receipt

12   of a CAS signal. Note that in the Diamond approach, all voice or data

13   communication is attenuated from the earpiece during the call waiting

14   cycle, thereby allowing the called party to have the annoyance of the

15   ACK signal at the earpiece of the CPE, albeit at a lower audible level than

16   if not attenuated at all. Advantageously, in my invention, the normal

17   audible Db level of sound may be heard at the CPE during voice

18   conversation while the selected portion of the frequency for signal that

19   corresponds to the ACK signal is not heard. Note however, that during

20   the initial period of filtering the ACK signal, the output from the

21   microphone could also be filtered through the notch filter before sending

22   any signals to the telephone line so as to not allow any corruption of the

23   ACK signal back to the LSO, although it is contemplated that the

24   complete voice signal could be allowed to pass through from the

25   microphone with minimal impact on the receipt by the LSO of the ACK

26   signal.

1   Figure 4 is a graph which depicts the frequency domain of voice

2   band 502 and out of band 502 signals which are on the talk loop of the

3   telephone apparatus. The Y-axis of Figure 4 represents the amplitude of

4   the frequency domain component. As is shown, notch filters may be

5   utilized to remove components in either the voice band 502 or in the out

6   of band portion 504. As is shown, notches 512, 514, 516 and 518 may

7   be provided to drop out selected portions of the frequency domain thus

8   rendering them substantially inaudible to either or both parties involved in

9   a telephone conference. Figure 4 depicts three alternative solutions.

10   The first solution is that of *Chaput* (discussed above) in which the entire

11   voice band 502 and out of band 504 components are muted, so there is

12   no need to filter or eliminate the acknowledgement signal through the

13   utilization of notch filters. An alternative approach is depicted by the

14   graph 508 for *Diamond* discussed above which teaches the continuation

15   of the voice band 502 portion and out of band portion 504. In the

16   present invention, the approach of Henderson is depicted by graph 506

17   in which there is neither muting nor attenuation of the voice band 502 or

18   out of band 504 portions of the frequency domain. Instead, notches

19   512, 514, 516, 518 are created at frequencies F_1, F_2, F_3 and F_n to

20   eliminate   the   frequency   components   which   make   up   the

21   acknowledgement signal. In most applications, the acknowledgement

22   signal is generated through utilization of a DTMF "D" tone which is

23   comprised of two frequency components. In accordance with the

24   present invention, one or more notch filters are provided which

25   substantially render the DTMF components inaudible to the parties

26   involved in the telephone conversation.

27

1   In FIGURE 5 is shown a block diagram schematic in which notch

2   filters F1 and F2 are selectively enabled or initiated by a CPU or

3   microprocessor in a CPE device as described earlier in this specification.

4   An IC notch filter similar to a circuit employing an LTC1062 in

5   connection with an LT 1056, a quad op amp circuit, or an integrated

6   high performance CAS detection chip that may be modified according to

7   the invention such as the PCC318 CIDCW, the PCC317, or the PCC306

8   by Pijnenberg Custom Chips, or some other software or hardware

9   implementation.

10   Figure 5 is a simplified schematic depiction of the present

11   invention. As is shown, a central processing unit 501 is provided to

12   control the operation of the telephone apparatus.   The telephone

13   apparatus may be equipped with a manual override switch 505. It is also

14   equipped with an electrically actuable switch 507 which serves to switch

15   notch filters 511, 513 into and out of the voice path.   A CPU also

16   electrically controls switch 515 which is also utilized to switch notch

17   filters 511, 513 into and out of the voice path. As is shown, the voice

18   and acknowledgement signal 509 are supplied as an input to switch 507.

19   CPU 501 determines the closure state of switch 507.   In one closure

20   condition, notch filters 511, 513 are completely bypassed, and the voice

21   and acknowledgement signal 509 are passed through switch 515 to the

22   handset 517.   When CPU 501 is utilized to switch 507 to another

23   closure condition, notch filter 511 and notch filter 513 are included in

24   the voice path. At the same time, CPU 501 actuates switch 515 in order

25   to switch notch filters 511, 513 into the voice path. Notch filter 511 is

26   adapted to filter out frequency components at frequency F_1 which is one

27   component of a two-tone DTMF "D" signal. Notch filter 513 is adapted

1 to filter out frequency F2 which corresponds to the other of the tones of

2 a two-tone DTMF "D" signal. The voice acknowledgement signal 509

3 may be passed serially through notch filters 511, 513. The filtered voice

4 and acknowledgement signal 509 is passed through switch 515 to

5 handset 517. The filter may be applied to audio output generated by

6 earpiece 519 and/or to the audio input supplied by microphone 521. In

7 Figure 5, CPU 501 is additionally shown as being connected to display

8 503 which may be utilized to display caller identification information.

9 In FIGURE 6 is shown a flow chart showing one preferred

10 embodiment operation. It is important to note that in some

11 embodiments, it is not necessary to mute, but rather, an attenuation

12 circuit could be employed. In other words, attenuation could occur

13 during the receipt of data from the LSO or immediately after, at some

14 time relative to, or simultaneous with the generation of the ACK signal

15 and/or initiation of the notch filter.

16 With reference now again to Figure 6, the process begins at block

17 601 and continues at block 603, wherein the telephone apparatus

18 receives an incoming CAS signal. Next, in accordance with step 605,

19 the CPU 501 examines the condition of extensions, in order to determine

20 whether or not extensions to the telephone apparatus are in an off-hook

21 condition. If the CPU determines that the extensions are indeed in an off-

22 hook condition, the process ends at block 607. However, if the CPU

23 determines that no extensions are off-hook in step 605, an

24 acknowledgement signal is generated in accordance with block 613.

25 Substantially concurrently with the generation of the acknowledgement

26 signal, and in accordance with block 609, CPU initiates the handset filter

27 by switching the DTMF filters into the earpiece circuit or the adjunct tip

1 and ring RJ 11. Next, in accordance with block 611, the two notch

2 filters utilized to eliminate the DTMF "D" signals F_1 and F_2. Then, in

3 accordance with block 615, the handset filter is maintained in an on

4 condition until the end of the acknowledgement signal. Next, control

5 passes to block 611, wherein the microphone is muted. Simultaneously,

6 in accordance with block 619, the earpiece is muted. During this mute

7 condition, the telephone apparatus receives the CID data in accordance

8 with block 221. Then, in accordance with some predetermined

9 condition, in accordance with block 623 the mute condition ends. The

10 logic represented by blocks 617, 619, 621, 623 may be performed in

11 any one of a number of alternative manners. It may be performed in

12 accordance with the present invention (the "Henderson" method) or in

13 accordance with the prior art method of *Diamond* or *Chaput*. In

14 accordance with the present invention, the acknowledgement signal and

15 the CID information are generated in accordance with conventional

16 Bellcore Specification. The present invention differs from the prior art in

17 that it utilizes one or more notch filters in order to eliminate the

18 frequency components associated with the acknowledgement signal. In

19 current implementations, acknowledgement signals are generated

20 through the utilization of a DTMF "D" tone which is composed of two

21 frequency components F_1 and F_2. Only these frequency components are

22 eliminated from the earpiece, voice band, high band, or out of band. In

23 other words, the notch filtering is provided which closely matches the

24 frequency components of the acknowledgement signal, whatever that

25 signal may be. In accordance with the present invention, except for the

26 voice components which are at the frequencies F_1 and F_2 the

27 conversation continues as is normal. It is not likely that participants in

28 the conversation will notice any substantial degradation in the

1   conversation due to the absence of two tiny frequency components F_1

2   and F_2 from the voice band portion of the talk loop. In accordance with

3   the present invention, any one of a number of alternative approaches

4   may be utilized to mute or attenuate the data signal which is provided to

5   the telephone apparatus in order to communicate the caller identification

6   information (CID).

7   The foregoing has described the principles and preferred

8   embodiments of the present invention. However, the invention should

9   not be construed as being limited to the particular embodiments

10   described. For example, different devices can be used from the

11   controllers, microprocessors, and tone generators described. Further,

12   some functions can be combined in a custom digital signal processing

13   chip. Thus, the above-described embodiments should be regarded as

14   illustrative rather than restrictive. Variations can be made to those

15   embodiments by workers skilled in the art without departing from the

16   scope of the present invention as defined by the following claims:

17

18